REMARKS

This response is submitted in reply to the Office Action dated July 30, 2003. Claims 1, 3, 4, 6, 8, 9 and 11-30 are pending in the patent application. Claim 30 has been amended. No new matter has been added by any of the amendments made herein. The Office Action rejects claims 1, 3, 4, 6, 8, 9 and 11-30 under 35 U.S.C. § 103. Applicants respectfully submit, for the reasons set forth below, that the rejections have been overcome or are improper. Accordingly, Applicants respectfully request reconsideration of the patentability of claims 1, 3, 4, 6, 8, 9 and 11-30.

Claims 1, 3, 4, 6, 8, 9 and 11-30 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,807,153 to Onaga et al. ("*Onaga*") in view of U.S. Patent No. 5,245,263 to Tsai et al. ("*Tsai*"), U.S. Patent No. 6,222,338 to Villaret ("*Villaret*") and U.S. Patent No. 6,064,167 to Takenaka et al. ("*Takenaka*"). Applicants submit that the combination of *Onaga*, *Tsai*, *Villaret* and *Takenaka* is improper and also does not teach or suggest the invention of claims 1, 3, 4, 6, 8, 9 and 11-30. Therefore, Applicants respectfully request that the patentability of these claims be reconsidered for the following reasons.

In order to combine references under 35 U.S.C. §103 there must be some teaching or suggestion within the references themselves or with the general knowledge available to those of ordinary skill in the art which would lead one skilled in the art to combine the teaching of the references in question. In the present case there is no such teaching or suggestion which would have led a person of ordinary skill in the art to combine the teachings of *Onaga*, *Tsai, Villaret* and *Takenaka* to arrive at the invention claimed in the present application.

Each of the independent claims 1, 4, 6, 9, 11, 13, 14, 16, 18, 19, 20, 22, 23, 25, 27 and 29 calls for either a joint control apparatus, robot apparatus, robot device or a control method for a robot apparatus for controlling the movement of a robot joint or robot device including an actuator. Each actuator includes at least an electric current detector for detecting a drive current of the actuator; torque detector for detecting the amount of torque based on the drive current detected by the electric current detector; and controller for controlling the actuator based on the amount of torque detected by the torque detector. Each of the electric current detectors, the torque detectors and the controllers are included in the actuator. Because the detectors and controllers are included in the actuator, the amount of wiring in the actual robot joint is reduced

and the overall joint design is simplified. Each of the method claims calls for, among other things, a method for controlling the movement of a robot joint or robot apparatus including the steps of detecting the drive current of an actuator using an electric current detector included in the actuator; detecting an amount of torque based on the drive current detected by the electric current detector using torque detector included in the actuator; and controlling the actuator using a controller based on the amount of detected torque.

The combination of references cited by the Patent Office does not disclose, teach or suggest the claimed invention. *Onaga* teaches a backup velocity monitor and protection system in a robot control system. The controls for controlling robot joints are typically controlled with a velocity control loop configuration that includes a velocity control for each joint motor. The velocity control loop uses joint motor velocity feedback usually generated by a sensor such as a tachometer to control the movements of the joints.

In *Onaga*, the control system is a multi-axis digital robot control which utilizes a torque processor board 600, a servo control board 400 and an AIF board 800 to provide complete control of all of the robot joints in the robot arm. (See Fig. 4) The backup velocity monitoring system independently monitors and determines the velocity of each joint motor from the electric current, terminal voltage and the motor inductance and resistance controlled by the above boards. As shown in Figs. 3 and 4, the robot arm dependent hardware and independent robot controls described above are external to or independent of the robot 20. The system described by *Onaga* makes comparisons between the primary and backup velocity signals for each joint motor using controls that are independent from the motors to identify any defective, erroneous or lost velocity feedback signals. (Col. 3, lines 1-8) If defective or erroneous velocity feedback signals are discovered, the backup mechanism provides the appropriate protective action.

Onaga is therefore concerned with providing a backup system that identifies defective and/or erroneous velocity feedback information from one or more joint motors to minimize and/or prevent undesirable joint movements in a robot and thereby prevent personal injury to operators and/or damage to property. *Onaga* is not concerned with reducing the complexity of the wiring of the robot or improving the mobility of the robot. In fact, adding a backup system arguably increases the wiring in the robot system. Additionally, the Patent Office states in the Office Action that *Onaga* does not "teach the actuator including a current detector, a torque

detector, and control means" as in the claimed invention (See the Office Action, page 5, lines 1-4).

The Patent Office relies on *Tsai* to remedy the deficiencies of *Onaga*. Specifically, the Patent Office alleges that *Tsai* discloses an actuator which includes control means, current detectors and torque detectors (see the Office Action, page 5, lines 6-8). However, *Tsai* does not disclose, teach or suggest such elements.

Tsai discloses a system for controlling backlash in gear-coupled transmission mechanisms. The system uses redundant unidirectional drives to continuously assure positive coupling of meshing gears in multiple Degrees Of Freedom (DOF) transmission systems. In particular, the system includes a closed loop controller including adaptive anti-backlash torque command means where the gears are always positively engaged in an operational state because the torque generated by the input drive devices of the gears is unidirectional. As shown in Fig. 10, the controller is independent of the backlash system (Col. 9, lines 17-21). The controller receives feedback signals from sensors on the actuators and then computes and generates the required torque command signals (i.e., "torque command" in Fig.10) to the actuators. (Col. 9, lines 11-17). *Tsai* is therefore concerned with controlling and thereby preventing backlash in devices having multiple degrees of freedom such as gear-driven machines and other similar devices using a controller which is independent and separate from the actuators in the system. Thus, *Tsai* does not teach or suggest an actuator for controlling a robot joint that includes an electric current detection device, a torque detection device and a control device *in the actuator itself* for controlling the operation of the actuator.

As is evident by the descriptions provided above, the teachings of *Onaga* are totally unrelated to the teachings of *Tsai*. In particular, one of ordinary skill in the art interested in developing a backup system to monitor the validity of a velocity feedback signal generated by servo-motors associated with robotic joints as taught by *Onaga*, would not have been motivated to employ the unidirectional torque method taught by *Tsai*. Furthermore, *Onaga* does not disclose, nor teach or suggest, that backlash is a problem in their joint mechanisms. In fact, employing an anti-backlash drive system or similar system is irrelevant to the problem addressed by *Onaga*. For these reasons, one of ordinary skill in the art would not have considered the *Tsai* reference useful in solving the problems in *Onaga*. In fact, neither reference is particularly

relevant to solve the problem of reducing the amount of complex wiring in the joints to improve the durability and mobility of the robot devices as solved by the claimed invention. Additionally, neither reference teaches or suggests such a problem or offers a solution to such a problem. Moreover, the Patent Office states that such a combination "inherently reduces" the wiring in the robot systems. (See the Office Action, page 5, lines 17-22). On the contrary, as described above, both references disclose complex control systems that require complex wiring configurations. Therefore, Applicants contend that such systems inherently increase the wiring required to operate those systems, rather than reduce the wiring.

The Patent Office adds *Villaret* and *Takenaka* to further clarify components allegedly disclosed by the combination of *Onaga* and *Tsai*. Specifically, the Patent Office states that *Villaret* discloses torque detectors, current detectors and an actuator or motor which are included in an "actuator case 31." The reference numeral 31, however, refers to servo controller 31 and reference numeral 37 refers to the actuator or motor (Col. 6, lines 15-24; Figs. 2-3). As shown in Fig. 2, the servo controller 31 is a separate and independent component from the motors 37. In fact as described in *Villaret*, the servo controller 31 receives an input from the encoder 36 and outputs current values to the motors 37 (Col. 6, lines 23-25). Specifically, the actual torques are outputted to the motors from the servo amplifier 51 and the position values are received from the encoder device 36 (which is not part of the motor 37) (Fig. 3; Col. 6 line 44 to Col. 7, line 9). Thus, the position and torque sensors and control devices are not located in the motor 37 or in the motor housing or case. As a result, *Villaret* does not teach or suggest including such elements in the motor to control the operation of the motor and minimize the wiring associated with a robot joint.

The Patent Office states that "applicant argues that Villaret shows the servo controller containing the elements and not the motor or actuator itself. However, a servo controller or mechanism can be considered an actuator, wherein the servo comprises the motor and the elements cited above [are] used in controlling the motor . . ." Applicants respectfully disagree with the Patent Office.

As described above, the servo controller and the motors are separate components. *Villaret* does not disclose, teach or suggest that the servo controller and the motors are a single unit or that these components are "provided together" as suggested by the Patent Office.

Additionally, whether the servo controller can be considered an actuator on a broader level is irrelevant. The use of the term servo controller does not mean that the servo controller is an actuator or even can be considered an actuator. When a claim term or terms are not "defined by [the] applicant in the specification, the words of the claim must be given their plain meaning." *Rexnord Corp. v Laitram Corp.*, 60 U.S.P.Q.2d 1851, 1854 (Fed Cir. 2001); see also MPEP § 2111.01. In Villaret, the term "servo controller" as used in Claims 8 and 11, is clearly defined in the specification as an "electronic system that controls the movements of the arms, by controlling the current supplied to the actuators." (Col. 3, lines 53-55). In addition, Fig. 2 clearly shows the servo controller and the motors as separate, independent components. *Villaret* therefore does not disclose, teach or suggest that the servo controller is an actuator or can be considered an actuator.

For these reasons, as described above, a person of ordinary skill in the art would not be motivated to combine *Onaga* and *Tsai* where there is no motivation or suggestion in either reference to perform such a combination. Moreover, due to the lack of any teaching or suggestion in the *Onaga*, *Tsai, Villaret* and *Takenaka* references themselves or within the general knowledge of those skilled in the art to combine any of these references, the Patent Office has not met its burden of establishing that the rejected claims are p*rima facie* obvious under 35 U.S.C. §103, and the final rejection of claims 1, 3, 4, 6, 8, 9 and 11-30 should be reversed.

Applicants respectfully submit that Claims 1, 3, 4, 6, 8, 9, 11-30 are novel and nonobvious over the art of record. For the foregoing reasons, Applicants respectfully request reconsideration of the patentability of these claims and earnestly solicit an early allowance of same.

No fees are due for this Response. If any other fees are due in connection with this application as a whole, the Patent Office is authorized to deduct such fees from Deposit Account 02-1818. If such a withdrawal is made, please indicate the attorney docket number (113298-002) on the account statement.

Respectfully submitted,

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